MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

TIT3131 – INFORMATION THEORY

(All sections / Groups)

12 October 2017
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages with **Five** questions only.
2. Attempt **All** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

QUESTION 1

(a) Describe source encoder and channel encoder in information theory.

[5 marks]

(b) A source emits one of the six possible symbols from a die which is biased in such a way that even numbers are two times as likely as odd numbers. Describe how to obtain the information rate of this source if one of the six symbols is emitted, once every microsecond.

[5 marks]

(c) Consider the two source codes described in the Table below, identify which source code is a prefix code. Give your reasons.

[2 marks]

Source symbol	Probability of occurrence	Code I	Code II
A	0.1	0	1
B	0.2	10	01
C	0.3	110	10
D	0.4	1110	010

QUESTION 2

(a) Explain the following codes I, II and III whether they are uniquely decodable using Kraft-McMillan inequality.

Symbol	*Code I*	*Code II*	*Code III*
A	0	0	00
B	101	10	01
C	100	11	11
D	111	111	10

[3 marks]

(b) Create the Huffman code for the following DMS and their probabilities and describe the efficiency of the code.

S	E	H	O	R	T	Y
P(S)	0.32	0.25	0.2	0.1	0.05	0.08

[8 marks]

(c) From your answer in **Question 2(b)**, decode "10010100111011000".

[1 mark]

QUESTION 3

(a) Describe three properties of mutual information.

[3 marks]

(b) Briefly describe the Shannon's first theorem, Source Coding Theorem.

[4 marks]

(c) Describe "Lossless Channel" using a suitable channel matrix.

[5 marks]

QUESTION 4

Consider a noisy channel with joint probabilities *p(y, x)* shown in the Table below.

$p(y_k, x_j)$	y_1	y_2	y_3
x_1	0.05	0.1	0.1
x_2	0.2	0.2	0.35

(a) Describe conditional entropy.

[2 marks]

(b) Compute *H(Y)* and *H(X)*.

[5 marks]

(c) Calculate H(Y|X), H(X|Y) and prove that *I(Y, X)* equal to *I(X, Y)*

[5 marks]

QUESTION 5

Consider the generator polynomial for a (6, 3) cyclic code generated by

$$g(D) = 1 + D^2 + D^3$$

(a) Draw the "***encoder***" and "***syndrome calculator***" for this code.

[2 Marks]

(b) Construct the generator matrix, G in "**systematic**" form.

[2 Marks]

(c) Construct all the valid code words for the following messages in "**non-systematic**" form.

[8 Marks]

Message	m(D)	c(D)	Codeword
000			
001			
010			
011			
100			
101			
110			
111			

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